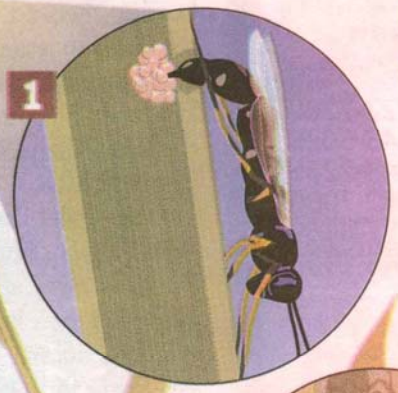
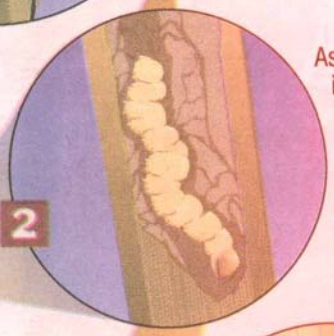
Sawing into profits

Over the last three decades, the sawfly has continued to emerge as one of the Montana wheat farmer's worst enemies, damaging more crop acres than any other insect pest. Drought conditions contributed to several of the worst sawfly infestations in years in Montana, causing an estimated $75 million to $100 million in lost income in the state. Sawflies damage the wheat plant's stem. That damage ultimately causes the plant to fall over, causing reduced yields and quality that can cost individual farmers tens of thousands of dollars.

How the insect does its damage:



The adult sawfly deposits its eggs near the top of a wheat stalk. It uses what is sometimes described as a "sawlike organ" to cut a hole and push eggs through.



As it grows, the sawfly larva works its way down the stalk, consuming the vascular tissue and leaving behind a trail of sawdust. Because the plant uses the tissue to transport nutrients to the grain, the parts above become stunted.

Source: Kurt Kammerzell, sawfly consultant; World Book Encyclopedia

Tribune graphic by Také Uda

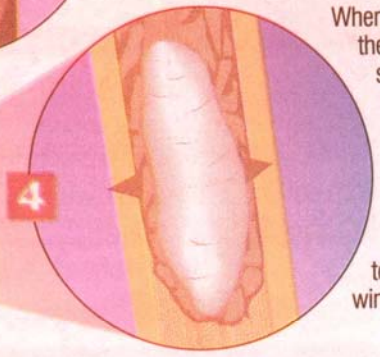
Detection tip: The first joint of a wheat stalk is often left blackened by a sawfly's passage.

Hymenoptera Order

- Formicidae (Ants)
- Apoidea (Bees)
- Vespoidea (Wasps)

Tenthredinidae (Sawflies)

After spending winter in the cocoon, the sawfly emerges from the stem of a wheat stalk that has been harvested or blown over. **Detection tip**: Infested stalks that have been blown over look as though they had been cut with a knife.



When the larva reaches the base of the wheat stalk, it encases itself in a cocoon. The process leaves a slit around the inside of the stalk, making it more susceptible to toppling over in high winds.

Drought plus cool, wet spring put teeth in sawfly infestation

By DAVID WEAVER
Associate MSU Professor

After several years of high temperatures, drought and lower prices, things looked more positive last summer as growers prepared for harvest.

Wheat prices were up considerably and plentiful rain and cooler temperatures gave promise of drought relief.

Unfortunately, the stems supporting expected higher yields were falling in alarming numbers in ripe fields of many growers.

The culprit was the wheat stem sawfly, hitting with more severity in 2008 than in recent memory.

Estimated Montana losses in 2008 hit $75 million to 100 million. Individual farmers had losses in the tens of thousands of dollars.

Several factors contributed to last year's greater losses.

The drought weakened natural sawfly enemy numbers, while the cool, wet spring and early summer favored survival of developing sawfly adults. It let the pests live longer and fly farther.

Cooler conditions prolonged the time that immature stages damaged wheat. Cloudy, rainy weather reduced the effectiveness of solid-stem wheat. Slowly maturing crops increased chances infested stems would fall over.

Description, history

Adults of this distinctive yellow and black insect are one-half inch long with shiny, smoky-black translucent wings.

They emerge after wintering in stem residue at or below the soil. Females lay 30 to 50 eggs inside stems during a one-week lifespan.

The feeding larvae tunnel inside the stem in the entire growing season, which reduces yield by disrupting the flow of nutrients to developing wheat kernels.

At harvest, mature larvae descend to the base of the ripened stem and cut it. They seal themselves in the lower stem, remaining below soil until spring.

The cut or "lodged" stems that clearly indicate sawfly damage were first reported in Canada in the 1890s and in the United States in the early 1900s.

Research to limit crop losses began in 1920, and focused on cultivation practices. It was found that tilling, early cutting, burning residue and trap crops all had limited effectiveness.

Insecticide use has never been shown to manage sawfly because of their biology, with successive weeks of adult flights and all other stages protected in stems.

The wheat stem sawfly is adaptive, expanding to readily

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PHOTO BY ROBERT PETERSON, MSU

What's left of the wheat stem after it's been cut by mature sawfly larva.

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exploit winter wheat several decades ago.

Over the last three decades, the sawfly has continued to emerge as one of the Montana wheat farmer's worst enemies, damaging more crop acres than any other insect pest.

Management varied

The first major tool in managing this pest was discovery of solid-stem wheat lines and the release of the first commercial cultivar, Rescue, in 1948. The pith in solid stem wheat kills a proportion of the immature stages and its stems do not fall over nearly as much at maturity.

Improving wheat cultivars remains a primary focus of sawfly management. Currently, Choteau spring wheat and Genou winter wheat represent popular varieties with good crop qualities.

Another strategy is planting other crops in rotations to break the pest cycle. These crops, such as oilseeds and legumes, will not support wheat stem sawfly development. Oat is unique among cereals in that it is invulnerable and can be included in rotations.

Additional strategies that were developed focused on improving harvest strategies by using practices such as swathing or combining in a single direction to recover fallen stems. Harvest equipment also evolved and recovers more by cutting closer to the ground.

Use of sawfly enemies

The wheat stem sawfly is abundant and its adults are fed upon at the time of flight by predators, especially birds such as horned larks and seagulls.

However, the most effective natural enemies of the wheat stem sawfly attack the immature stages inside the stem.

Two bright orange species of parasitoids kill wheat stem sawfly in cereal crops. These closely related insects are known only by Latin names, *Bracon cephi* and *Bracon lissogaster*. Of the two, *Bracon cephi* is more widespread.

Parasitic wasps detect specific odors as chemical signals from plants being damaged by insects.

This allows the female wasp to fly to the stem containing the larva. The larva creates characteristic vibrations that the female wasps hear by laying their antennae on the side of the stem, walking along and drumming.

Once they spot where the

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larva is located, the female wasp rapidly turns and drives her stinger through the stem wall and into the larva body, releasing a toxin that paralyzes it. She also lays an egg on the paralyzed larva. The egg hatches and the larva drinks the body fluids of the paralyzed sawfly.

These parasitoids have two generations per year. New adults chew holes in the side of the stem that do no harm to it.

New research continues

Facilities in Montana, North Dakota and the Canadian prairies research development and best use of better solid-stem wheat cultivars and sawfly natural enemies.

At Montana State University, a large research effort supported by state and federal funds is exploring new methods.

PHOTO/DEPT. OF ENTOMOLOGY/UNIVERSITY OF NEBRASKA-LINCOLN

An adult female wheat-stem sawfly.

A lot of funding supports technical and undergraduate labor collecting and dissecting wheat stems since the pest is entirely hidden inside the stem. This provides baseline data to help weigh potential strategies.

Here are two examples of new research findings:

- **Chemical signals** — Insects use airborne molecules called pheromones to communicate with and attract other species members. A series of potential pheromone compounds were

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identified from adult male and female sawflies. For several years these have been tested in experimental traps next to developing crops. A single chemical is effective as a lure and could be commercially developed for use to monitor and predict sawfly population size and potential damage.

Wheat also produces several compounds that are attractive to female wheat stem sawflies.

Some varieties produce a lot of these materials and others less. Female sawflies prefer the plants releasing a lot of signals. Genetic research has identified potential molecular markers for the release of these attractants. Using less-attractive varieties in companion planting has great potential as a management approach and can be sped up by using genetic tools.

Future research in this area could include combining varying levels of attraction with solid stems to reduce sawfly numbers. Another more distant research area is identifying varieties that produce more attractants for parasitoids.

● **Biological control** — A lot of research has gone into this area. Parasitoids survive better in untilled or lightly tilled soil, but the amount of tillage has no direct effect on overall sawfly numbers. Also parasitoids are located in the bottom of the stem and can be conserved by adjusting a combine or swather to cut higher. Parasitoids have two generations per year, but if winter wheat ripens quickly the second generation may not fully develop. So an occasional spring wheat crop will benefit parasitoid populations.

> "An occasional spring wheat crop will benefit parasitoid populations."
>
> *– David Weaver, associate professor, MSU*

There's been a big effort to redistribute parasitoids since 2003. A large population of parasitoids is harvested from crop residue. Sorted residue calculated to have 500 female parasitoids is placed in a growing crop to establish a starter population that will grow and suppress sawflies. More than 50 fields in 15 counties have received this material.

Natural disease outbreaks have been spotted in sawflies for the first time, and several fungal species responsible have been identified. Some of them kill only insects, not plants. These may be potential agents for biological control.

Continuing challenges

Other important research is being addressed, such as finding new sources of host-plant resistance.

One longer-term project will determine the chemical factors in oat that kill immature sawflies. Once the mechanism has been identified, we'll see if it can ultimately be expressed in wheat.

Another area of research is to better-understand how losses in kernel yield due to larval feeding vary by wheat variety, so that more tolerance can be incorporated into existing wheat lines.

But there are financial challenges to continuing all these research efforts, including scrutinizing new biological control agents, developing best cultivation practices to minimize yield losses and variety development.

That's because research success is directly linked to available funds and the wheat stem sawfly is not well known nationally.

While the dollars lost because of the sawfly are large, it's considered a regional pest spread over a fairly small area of wheat production, especially south of the Canadian border. In the United States, the sawfly is the key dominant pest only from east of the Continental Divide in Montana through western North Dakota.

Although there are regional funds supporting sawfly research, there is little opportunity to develop long-term, well-funded multistate research efforts. This certainly adds to the challenge that sawflies can't be controlled with insecticides as can most other nationally prominent insect pests.

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